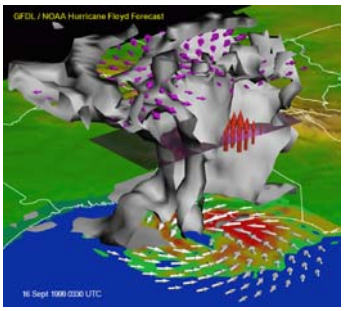
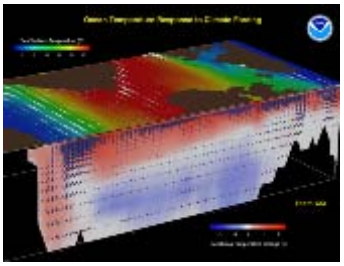
Geophysical Fluid Dynamics Laboratory

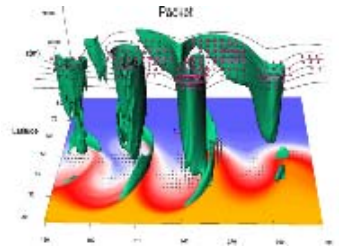
Modeling the Earth's climate and weather



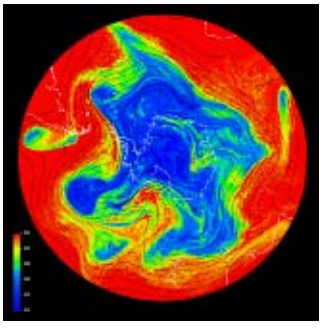
Forecasting Hurricane Floyd



Ocean Thermal Response to Climate Forcing



"Packet" Structure in Storm Tracks



High Altitude Atmospheric Mixing

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What does the Geophysical Fluid Dynamics Laboratory do for the nation?

The Geophysical Fluid Dynamics Laboratory (GFDL) develops and uses mathematical models and computer simulations to improve our understanding and predictions of the behavior of the atmosphere, the oceans, and the climate system.

GFDL has focused not only on model-building relevant for NOAA operations, as in hurricane modeling, but also on using models to address issues of importance to society at large, global warming being a prime example. GFDL scientists create and use complex computer applications to carry out this research using state-of-the-art supercomputer and data storage resources. These mathematical models have become key tools, not only to predict tomorrow's weather, but also to understand the physical processes that control this near-term weather as well as the earth's climate, years into the future. Over its 45-year history, GFDL has set the agenda for much of the world's research on modeling of global climate change, and has played a significant role in World Meteorological Organization and the Intergovernmental Panel on Climate Change assessments. Many of the key scientific issues in the area of climate change were first addressed in papers published by GFDL.

Research at GFDL, based on model simulations, theory, and observational studies, has also resulted in a host of insights into fundamental atmospheric and oceanic processes, ranging over such problems as tropical variability, midlatitude storm tracks, the stratospheric circulation, atmospheric responses to the El Niño-Southern Oscillation (ENSO), convection-cloud-radiation interactions, the global thermohaline circulation, and the transport of trace constituents. It is strongly felt within GFDL that this broad set of activities leads to more accurate prediction of phenomena in the atmosphere and oceans, on land or in the cryosphere, on daily, seasonal, decadal or centennial time scales.

Recent Accomplishments:

- The Modular Ocean Model, affectionately known as MOM, is an evolving code that is used within GFDL for climate modeling, research on seasonal-to-interannual (SI) variability and predictability, and (in collaboration with Princeton University) modeling of the carbon cycle. ***Payoffs: MOM has been publicly available for a decade and is used by a large fraction of the researchers worldwide working with global ocean models. It is used operationally by the Climate Prediction Center of NCEP. It has recently been configured for use by a consortium of groups (GFDL, IRI, NCEP, COLA, and NCAR) for coordinated research on SI predictability.***

- GFDL has developed a hurricane prediction system that has very significantly improved predictions of hurricane and typhoon tracks. Recent work on intensity prediction with a coupled atmosphere-ocean model is also very promising. The story of this model's development can be used to symbolize GFDL's research style -- a model meticulously developed for fundamental research into hurricane dynamics evolves, over more than a decade, into a valuable operational tool. ***Payoffs: NCEP and the U.S. Navy have adopted the GFDL hurricane model for operational use.***

- In 1995, GFDL began development of the first ever Flexible Modeling System (FMS) that is designed to create a central framework from which a wide variety of specialized atmospheric and oceanic mathematical models can be created. This innovation is now demonstrating a sharply improved ability to prepare models, greater ease of use, and an increased efficiency in utilization of scarce scientific talent. ***Payoffs: FMS is now attracting new researchers worldwide who are working cooperatively with GFDL on its contribution to the next generation of NOAA's weather and climate prediction models.***

- GFDL has made major contributions to the 2000 Intergovernmental Panel on Climate Change (IPCC) Climate Change Assessment. The IPCC is an international process designed to produce objective assessments of the state of scientific understanding of human-caused climate warming and evaluate the options of what the world can do to reduce its impact. ***Payoffs: GFDL contributed two lead authors to the assessment report and provided many new results from its mathematical model of the earth's climate system.***

What's next for GFDL?

- Integrating the new massively parallel supercomputer system into its research programs and optimizing major models to make best use of the new system's capabilities.

- Modifying the Hurricane model to improve use of new data sources inside hurricanes, and in their near vicinity.

- Continue improving the FMS system, increasing its robustness to multiple applications, improving the fidelity of its various sub-models of physical processes, and optimizing its ability to run models efficiently on massively parallel computers.

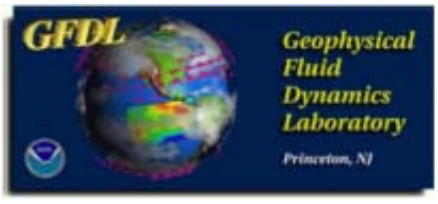
- Focusing research on climate change detection/attribution, and assessing the roles of natural climate variability and anthropogenic causes in climate change. This work is critical for evaluating the credibility of mathematical models for providing reliable projections of future climate change and how the earth's ecosystems will be affected by such changes.

Research Partnerships

GFDL has research partnerships with a number of organizations inside and outside of NOAA, totaling several hundred active collaborations. Within NOAA, it has active research programs with other NOAA Research laboratories and NWS/NCEP. Within the federal government, GFDL scientists have collaborations with NSF/UCAR, NASA, and DOE, among others. GFDL has a cooperative agreement with Princeton's Atmospheric and Oceanic Sciences Program as well as collaborations within the academic community and with research institutions overseas. A complete listing of GFDL's 2003 research collaborations is available on the GFDL website.

Budget and Staff

The FY 2003 enacted budget for the GDFL budget lines totaled $24.2M (including PAC), and its request for FY 2004 totaled $25.8M. GFDL has 84 federal employees, 29 contractors, and 26 Joint Institute employees.



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